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TITLE: Broken Ergodicity in MHD Turbulence in a Spherical Domain

PRESENTATION TYPE: Assigned by Committee (Oral or Poster)

CURRENT SECTION/FOCUS GROUP: Nonlinear Geophysics (NG)

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ABSTRACT: Broken ergodicity (BE) occurs in Fourier method numerical simulations of ideal, homogeneous, incompressible magnetohydrodynamic (MHD) turbulence. Although naïve statistical theory predicts that Fourier coefficients of fluid velocity and magnetic field are zero-mean random variables, numerical simulations clearly show that low-wavenumber coefficients have non-zero mean values that can be very large compared to the associated standard deviation. In other words, large-scale coherent structure (i.e., broken ergodicity) in homogeneous MHD turbulence can spontaneously grow out of random initial conditions. Eigenanalysis of the modal covariance matrices in the probability density functions of ideal statistical theory leads to a theoretical explanation of observed BE in homogeneous MHD turbulence. Since dissipation is minimal at the largest scales, BE is also relevant for resistive magnetofluids, as evidenced in numerical simulations. Here, we move beyond model magnetofluids confined by periodic boxes to examine BE in rotating magnetofluids in spherical domains using spherical harmonic expansions along with suitable boundary conditions. We present theoretical results for 3-D and 2-D spherical models and also present computational results from dynamical simulations of 2-D MHD turbulence on a rotating spherical surface. MHD turbulence on a 2-D sphere is affected by Coriolus forces, while MHD turbulence on a 2-D plane is not, so that 2-D spherical models are a useful (and simpler) intermediate stage on the path to understanding the much more complex 3-D spherical case.